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RADIOACTIVE RELEASE DATA FROM CANADIAN NUCLEAR GENERATING STATIONS 1972 TO 1986

Compiled by
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Report

RADIOACTIVE RELEASE DATA FROM CANADIAN NUCLEAR GENERATING STATIONS FOR THE PERIOD OF: 1972-1986

ACKNOWLEDGEMENT

The first edition of this report was published in September 1986, covering the period 1972 to 1985. Several comments and suggestions for improvement were received and taken into account when preparing this edition.

A. INTRODUCTION

Derived Release Limits (DRLs) are established for controlling releases of radioactive materials from licensed nuclear generating stations during routine operations. DRLs are calculated rate values for releases which, if reached, would, according to a calculational model, result in the maximum permitted radiation dose to a member of the public living at the boundary of the facility, considering all environmental pathways of exposure. The dose limits set out in the Atomic Energy Control Regulations for members of the public are given in Table 1.

Table 1. Statutory Dose Limits - Public

Organ or Tissue	Annual Dose Limits
Whole-Body, Gonads, Red Bone Marrow	0.5 rem (5 mSv)
Skin, Bone, Thyroid	3 rem (30 mSv) (1/2 this value for children up to 16 yrs.)
Other Single Organs or Tissues	1.5 rem (15 mSv)
Extremities	7.5 rem (75 mSv)

Since more than one radionuclide is released, and both airborne and waterborne pathways are involved, a summation must be done to express the overall release of radioactive materials in a meaningful way. Dose limitation requirements will be met if during operations:

$$\Sigma \frac{R_{ij}}{DRL_{ij}} \leq 1$$

where R_{ij}=actual release of radionuclide i from mode of release j;
and DRL_{ij}=Derived Release Limit for radionuclide i from mode of release j.

When deriving the release limits, site-specific data or appropriate default values are used in the pathways analysis model. Input parameters used in the model are conservative, and this inherent conservatism ensures that if the releases are below the DRL values, the annual dose limits will be respected.

It should be noted that, because of the conservativism in the DRL calculations, any attempt to determine an actual individual dose by prorating the release data may result in an overestimate.

B. STATION LIMITS

The DRLs for Canadian nuclear generating stations are given in Table 2. They are expressed on an annual basis but it should be noted that, for licensing purposes, DRLs are customarily broken down into weekly or monthly values, depending on the mode of release (atmosphere or water), to limit the rate of release over relatively short periods. As new information becomes available the values of DRLs may change from time to time.

Notes to tables 2a and 2b:

a. All units are in terabecquerels per annum (TBq/a) except for noble gases. (1 TBq=10^{12} Bq=27 curies) Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.

b. At the time that Pickering B emission limits were derived, the limits for Pickering A were reviewed. The result is that new DRLs for gaseous emissions apply as of January 1983 (numbers in parentheses). The DRLs for liquid emissions remain unchanged.

c. The dose limits apply to each of the stations (Pickering A and Pickering B) and accordingly separate DRLs have been calculated.

d. Being decommissioned.

e. Being decommissioned.

f. As of 1986, C-14 effluent monitoring results are reported from Pickering A where it is a specific licence requirement. At present, environmental monitoring of C-14 is being conducted around the Bruce site in order to determine the importance of its emission and whether effluent monitoring will be necessary in future years.

g. In 1986, in view of the decommissioning state of the reactor, the DRLs for waterborne releases for Douglas Point were revised.

h. The DRLs for waterborne releases for Point Lepreau are much higher than for other 600 MWe station because the drinking water is not a pathway to man (the receiving body of the effluent is salt water).

i. Numbers are sometimes expressed in exponent form. For example 5×10^5 means 500000.

Table 2a. Annual derived release limits [a] for radionuclide components from nuclear generating stations in Canada

Station / Component	2.1 AIRBORNE RELEASES				
	Tritium	Iodine -131	Noble Gases	Particulates	C-14[f]
	(2.7×10^5)[b]	(4.2)	(10.4×10^4)	(10.8)	
Pickering A[c] (4 units)	3.8×10^5	0.8	8.7×10^4	1.9	2.7×10^3
Pickering B[c] (4 units)	2.7×10^5	4.2	10.4×10^4	10.8	
Douglas Point[d]	15.0×10^5	6.0	29.0×10^4	14.0	
NPD	6.7×10^5	11.5	15.0×10^4	29.0	
Bruce A (4 units)	3.8×10^5	3.3	8.3×10^4	8.3	
Bruce B (4 units)	6.1×10^5	3.3	44.0×10^4	8.3	
Gentilly-1[e]	10.0×10^5	3.5	4.6×10^4	8.6	
Gentilly-2	3.5×10^5	1.7	8.1×10^4	4.6	
Point Lepreau	15.6×10^5	2.6	36.0×10^4	7.8	

Table 2b. Annual derived release limits [a] for radionuclide components from nuclear generating stations in Canada

Station	Component	2.2 WATERBORNE RELEASES	
		Tritium	Gross beta
Pickering A (4 units)		6.2×10^5	34.0
Pickering B (4 units)		6.2×10^5	34.0
Douglas Point		3.5×10^5	2.0
		(2.7×10^3)[g]	(0.15)[g]
NPD		1.0×10^5	5.3
Bruce A (4 units)		5.3×10^5	28.0
Bruce B (4 units)		5.3×10^5	28.0
Gentilly-1		0.9×10^5	4.9
Gentilly-2		1.6×10^5	8.9
Point Lepreau		468×10^5[h]	113[h]

C. RELEASE DATA

Radioactive release data from Canadian nuclear generating stations in the years 1972 to 1986 are reported in Tables 3a through 11b.

Station	Page
Pickering A	6-7
Pickering B	8-9
Douglas Point	10-11
NPD	12-13
Bruce A	14-15
Bruce B	16-17
Gentilly 1	18-19
Gentilly 2	20-21
Point Lepreau	22-23

Table 3a. Annual activity released in gaseous effluents from Pickering NGS "A"

Year[d]	Radionuclides[a]	Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]	C-14[c]	% DRL
1972		5.3×10^{2}	0.20	49.0×10^{-5}	0.01	180.0×10^{2}	17.30	50.0×10^{-5}	<0.01		
1973		14.0×10^{2}	0.52	20.0×10^{-5}	<0.01	150.0×10^{2}	14.40	41.0×10^{-5}	<0.01		
1974		9.2×10^{2}	0.34	15.0×10^{-5}	<0.01	1.6×10^{2}	0.15	140.0×10^{-5}	<0.01		
1975		7.6×10^{2}	0.28	4.1×10^{-5}	<0.01	1.9×10^{2}	0.18	27.0×10^{-5}	<0.01		
1976		8.9×10^{2}	0.33	5.6×10^{-5}	<0.01	1.0×10^{2}	0.10	10.0×10^{-5}	<0.01		
1977		16.0×10^{2}	0.59	6.7×10^{-5}	<0.01	1.6×10^{2}	0.15	27.0×10^{-5}	<0.01		
1978		9.6×10^{2}	0.36	5.6×10^{-5}	<0.01	1.5×10^{2}	0.14	11.0×10^{-5}	<0.01		
1979		15.0×10^{2}	0.55	7.8×10^{-5}	<0.01	2.2×10^{2}	0.21	4.1×10^{-5}	<0.01		
1980		6.8×10^{2}	0.25	16.0×10^{-5}	<0.01	2.4×10^{2}	0.23	12.0×10^{-5}	<0.01		
1981		5.8×10^{2}	0.21	6.3×10^{-5}	<0.01	2.5×10^{2}	0.24	17.0×10^{-5}	<0.01		
1982		6.8×10^{2}	0.25	6.9×10^{-5}	<0.01	2.2×10^{2}	0.21	17.0×10^{-5}	<0.01		
1983		6.6×10^{2}	0.17	13.0×10^{-5}	<0.01	3.5×10^{2}	0.40	2.7×10^{-5}	<0.01		
1984		4.3×10^{2}	0.11	6.2×10^{-5}	<0.01	1.7×10^{2}	0.19	2.1×10^{-5}	<0.01		
1985		3.9×10^{2}	0.10	5.6×10^{-5}	<0.01	1.9×10^{2}	0.22	27.0×10^{-5}	<0.01		
1986		3.5×10^{2}	0.09	6.7×10^{-5}	<0.01	1.8×10^{2}	0.21	10.7×10^{-5}	<0.01	13.3	0.50

a. All units are in TBq/a except for noble gases. (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.
b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of DRL.
c. Measurement as $^{14}CO_2$.
d. Start-up year 1971.

Table 3b. Annual activity released in liquid effluents from Pickering NGS "A"

Year[c]	Radionuclides[a] Tritium	% DRL	Gross Beta	% DRL[b]
1972	0.4×10^{2}	<0.01	10.0×10^{-2}	0.30
1973	1.9×10^{2}	0.03	6.7×10^{-2}	0.20
1974	5.4×10^{2}	0.09	9.6×10^{-2}	0.28
1975	3.9×10^{2}	0.06	3.7×10^{-2}	0.11
1976	2.2×10^{2}	0.03	3.0×10^{-2}	0.09
1977	7.0×10^{2}	0.11	3.0×10^{-2}	0.09
1978	120.0×10^{2}	1.93	3.0×10^{-2}	0.09
1979	140.0×10^{2}	2.26	3.7×10^{-2}	0.11
1980	4.7×10^{2}	0.07	1.3×10^{-2}	0.04
1981	2.8×10^{2}	0.04	0.8×10^{-2}	0.02
1982	3.7×10^{2}	0.06	1.8×10^{-2}	0.05
1983	3.7×10^{2}	0.06	3.3×10^{-2}	0.10
1984	3.3×10^{2}	0.05	2.7×10^{-2}	0.08
1985	3.3×10^{2}	0.05	3.2×10^{-2}	0.09
1986	0.8×10^{2}	0.01	2.0×10^{-2}	0.06

a. All units are in TBq/a
b. The most restrictive DRL value of all radionuclides is used to calculate the released percentage of DRL.
c. Start-up year 1971.

Table 4a. Annual activity released in gaseous effluents from Pickering NGS "B"

Year[c]	Radionuclides[a]	Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]
1984		0.5×10^{2}	0.02	1.6×10^{-4}	<0.01	1.7×10^{2}	0.16	1.2×10^{-5}	<0.01
1985		1.4×10^{2}	0.05	0.4×10^{-4}	<0.01	1.8×10^{2}	0.17	1.3×10^{-5}	<0.01
1986		1.9×10^{2}	0.07	0.6×10^{-4}	<0.01	2.7×10^{2}	0.26	1.5×10^{-5}	<0.01

a. All units are in TBq/a except for noble gases (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.

b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of DRL.

c. Start-up year 1982.

Table 4b. Annual activity released in liquid effluents from Pickering NGS "B"

Year[c]	Radionuclides[a]	Tritium	% DRL	Gross beta	% DRL[b]
1984		3.3×10^{2}	0.05	2.7×10^{-2}	0.08
1985		3.8×10^{2}	0.06	0.9×10^{-2}	0.03
1986		8.4×10^{2}	0.13	2.1×10^{-2}	0.06

a. All units are in TBq/a.
b. The most restrictive DRL value of all radionuclides is used to calculate the released percentage of DRL.
c. Start-up year 1982.

Table 5a. Annual activity released in gaseous effluents from Douglas Point NGS

Year[c]	Radionuclides[a] Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]
1972	2.7×10^{2}	0.02	0.1×10^{-5}	<0.01	2.7×10^{3}	0.93	5.6×10^{-6}	<0.01
1973	7.4×10^{2}	0.05	71.0×10^{-5}	0.01	5.0×10^{3}	1.72	24.0×10^{-6}	<0.01
1974	1.9×10^{2}	0.01	180.0×10^{-5}	0.03	0.8×10^{3}	0.28	18.0×10^{-6}	<0.01
1975	5.5×10^{2}	0.04	130.0×10^{-5}	0.02	1.0×10^{3}	0.34	13.0×10^{-6}	<0.01
1976	13.0×10^{2}	0.09	60.0×10^{-5}	0.01	1.0×10^{3}	0.34	8.5×10^{-6}	<0.01
1977	4.3×10^{2}	0.03	34.0×10^{-5}	<0.01	0.3×10^{3}	0.10	6.3×10^{-6}	<0.01
1978	6.1×10^{2}	0.04	34.0×10^{-5}	<0.01	0.4×10^{3}	0.14	8.9×10^{-6}	<0.01
1979	2.4×10^{2}	0.02	4.2×10^{-5}	<0.01	0.7×10^{3}	0.24	8.1×10^{-6}	<0.01
1980	1.5×10^{2}	0.01	6.0×10^{-5}	<0.01	0.2×10^{3}	0.07	3.6×10^{-6}	<0.01
1981	4.2×10^{2}	0.03	440.0×10^{-5}	0.07	1.2×10^{3}	0.41	36.0×10^{-6}	<0.01
1982	3.2×10^{2}	0.02	340.0×10^{-5}	0.06	2.3×10^{3}	0.79	17.0×10^{-6}	<0.01
1983	3.7×10^{2}	0.02	5.4×10^{-5}	<0.01	1.7×10^{3}	0.59	4.8×10^{-6}	<0.01
1984	3.2×10^{2}	0.02	1.6×10^{-5}	<0.01	1.2×10^{3}	0.41	2.9×10^{-6}	<0.01
1985	2.6×10^{2}	0.02	ND	-	ND	-	ND	-
1986	1.1	<0.01	NM	-	NM	-	ND	-

ND - not detected
NM - no longer measured

a. All units are in TBq/a except for noble gases (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.

b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of DRL.

c. Start-up year 1966.

Table 5b. Annual activity released in liquid effluents from Douglas Point NGS

Year[d]	Radionuclides[a]	Tritium	% DRL	Gross Beta	% DRL[b]
1972		1.6×10^{2}	0.05	15.0×10^{-2}	7.50
1973		2.8×10^{2}	0.08	7.4×10^{-2}	3.70
1974		1.3×10^{2}	0.04	4.4×10^{-2}	2.20
1975		1.0×10^{2}	0.03	3.0×10^{-2}	1.50
1976		1.7×10^{2}	0.05	3.0×10^{-2}	1.50
1977		0.7×10^{2}	0.02	0.7×10^{-2}	0.35
1978		0.4×10^{2}	0.01	0.7×10^{-2}	0.35
1979		1.3×10^{2}	0.04	0.9×10^{-2}	0.45
1980		1.3×10^{2}	0.04	1.0×10^{-2}	0.50
1981		0.8×10^{2}	0.02	0.7×10^{-2}	0.35
1982		1.2×10^{2}	0.03	1.9×10^{-2}	0.95
1983		4.0×10^{2}	0.01	1.6×10^{-2}	0.80
1984		1.4×10^{2}	0.04	0.2×10^{-2}	0.10
1985		0.5×10^{2}	0.01	0.8×10^{-2}	0.40
1986[c]		2.0	0.07	0.1×10^{-2}	0.60

a. All units are in TBq/a.
b. The most restrictive DRL of all radionuclides is used to calculate the released percentage of DRL.
c. In 1986, new reduced DELs = H-3; 2.7×10^{3} TBq/a (before, 3.5×10^{5}): Gross Beta; 0.15 TBq/a (before, 2)
d. Start-up year 1966.

Table 6a. Annual activity released in gaseous effluents from NPD

Year[c]	Radionuclides[a]	Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]
1972		1.4×10^{2}	0.02	6.7×10^{-10}	<0.01	0.6×10^{3}	0.40	ND	-
1973		4.9×10^{2}	0.07	140.0×10^{-5}	<0.01	4.5×10^{3}	3.00	410.0×10^{-6}	<0.01
1974		2.8×10^{2}	0.04	4.8×10^{-5}	<0.01	4.1×10^{3}	2.70	ND	-
1975		4.7×10^{2}	0.07	ND	-	1.8×10^{3}	1.20	5.0×10^{-6}	<0.01
1976		5.5×10^{2}	0.08	ND	-	1.9×10^{3}	1.30	ND	-
1977		6.6×10^{2}	0.10	ND	-	1.5×10^{3}	1.00	ND	-
1978		7.4×10^{2}	0.11	ND	-	1.3×10^{3}	0.90	ND	-
1979		8.4×10^{2}	0.12	ND	-	1.5×10^{3}	1.00	ND	-
1980		4.4×10^{2}	0.07	ND	-	1.4×10^{3}	0.90	ND	-
1981		7.8×10^{2}	0.12	ND	-	0.9×10^{3}	0.60	ND	-
1982		4.3×10^{2}	0.06	ND	-	0.8×10^{3}	0.50	ND	-
1983		5.2×10^{2}	0.08	ND	-	1.4×10^{3}	0.90	ND	-
1984		4.4×10^{2}	0.07	ND	-	1.7×10^{3}	1.10	ND	-
1985		3.7×10^{2}	0.05	ND	-	1.8×10^{3}	1.20	ND	-
1986		3.8×10^{2}	0.06	ND	-	3.1×10^{3}	2.10	ND	-

ND = not detected

a. All units are in TBq/a except for noble gases (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.

b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of DRL.

c. Start-up year 1962.

Table 6b. Annual activity released in liquid effluents from NPD

Year[c]	Radionuclides[a]	Tritium	% DRL	Gross Beta	% DRL[b]
1972		27.0	0.03	1.0×10^{-3}	0.02
1973		180.0	0.18	3.7×10^{-3}	0.07
1974		35.0	0.03	3.7×10^{-3}	0.07
1975		82.0	0.08	4.7×10^{-3}	0.09
1976		55.0	0.05	1.2×10^{-3}	0.02
1977		36.0	0.04	1.4×10^{-3}	0.03
1978		51.0	0.05	2.4×10^{-3}	0.04
1979		190.0	0.19	1.3×10^{-3}	0.02
1980		170.0	0.17	0.9×10^{-3}	0.02
1981		300.0	0.30	1.2×10^{-3}	0.02
1982		94.0	0.09	0.6×10^{-3}	0.01
1983		84.0	0.08	1.6×10^{-3}	0.03
1984		22.0	0.02	24.0×10^{-3}	0.45
1985		127.0	0.13	27.0×10^{-3}	0.51
1986		71.0	0.07	6.7×10^{-3}	0.13

a. All units are in TBq/a.
b. The most restrictive DRL value of all radionuclides is used to calculate the released percentage of the DRL.
c. Start-up year 1962.

Table 7a. Annual activity released in gaseous effluents from Bruce NGS "A"

Year[c]	Radionuclides[a] Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]
1976	0.1×10^{3}	0.03	1.8×10^{-9}	<0.01	0.2×10^{2}	0.02	0.7×10^{-5}	<0.01
1977	0.3×10^{3}	0.08	4.6×10^{-4}	0.01	13.0×10^{2}	1.60	9.2×10^{-5}	<0.01
1978	0.5×10^{3}	0.13	1.1×10^{-4}	0.03	15.0×10^{2}	1.80	140.0×10^{-5}	0.02
1979	1.4×10^{3}	0.37	5.0×10^{-4}	0.01	30.0×10^{2}	3.60	13.0×10^{-5}	<0.01
1980	1.6×10^{3}	0.42	1.3×10^{-4}	<0.01	8.3×10^{2}	1.00	5.7×10^{-5}	<0.01
1981	3.4×10^{3}	0.89	1.0×10^{-4}	<0.01	6.1×10^{2}	0.70	9.5×10^{-5}	<0.01
1982	1.5×10^{3}	0.39	12.0×10^{-4}	<0.01	5.1×10^{2}	0.60	8.9×10^{-5}	<0.01
1983	3.9×10^{3}	1.03	3.7×10^{-4}	0.01	6.7×10^{2}	0.80	5.0×10^{-5}	<0.01
1984	2.5×10^{3}	0.66	28.0×10^{-4}	0.08	8.0×10^{2}	1.00	5.9×10^{-5}	<0.01
1985	1.5×10^{3}	0.39	0.5×10^{-4}	<0.01	8.0×10^{2}	1.00	44.0×10^{-5}	<0.01
1986	1.8×10^{3}	0.47	1.0×10^{-4}	<0.01	5.6×10^{2}	0.70	40.4×10^{-5}	<0.01

a. All units are in TBq/a except for noble gases (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.

b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of DRL.

c. Start-up year 1976.

Table 7b. Annual activity released in liquid effluents from Bruce NGS "A"

Year[c]	Radionuclides[a] Tritium	% DRL	Gross Beta	% DRL[b]
1976	1.4	<0.01	0.1×10^{-2}	<0.01
1977	0.3×10^{2}	<0.01	2.3×10^{-2}	0.08
1978	1.5×10^{2}	0.03	18.0×10^{-2}	0.64
1979	5.5×10^{2}	0.10	21.0×10^{-2}	0.75
1980	9.0×10^{2}	0.17	16.0×10^{-2}	0.57
1981	7.4×10^{2}	0.14	8.0×10^{-2}	0.03
1982	9.7×10^{2}	0.18	8.0×10^{-2}	0.03
1983	16.0×10^{2}	0.30	7.1×10^{-2}	0.24
1984	6.0×10^{2}	0.11	7.2×10^{-2}	0.26
1985	10.6×10^{2}	0.20	9.0×10^{-2}	0.32
1986	13.8×10^{2}	0.26	12.0×10^{-2}	0.43

a. All units are in TBq/a.
b. The most restrictive values of all radionuclides is used to calculate the released percentage of DRL.
c. Start-up year 1976.

Table 8a. Annual activity released in gaseous effluents from Bruce NGS "B"

Year[c]	Radionuclides[a]	Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]
1984		2.6	<0.01	4.4×10^{-6}	< 0.01	28.7	< 0.01	1.2×10^{-4}	<0.01
1985		98.6	0.02	52.0×10^{-6}	< 0.01	106.3	0.02	2.1×10^{-4}	<0.01
1986		163.5	0.03	62.0×10^{-6}	< 0.01	126.9	0.03	3.5×10^{-4}	<0.01

a. All units are in TBq/a except noble gases (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.
b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of DRL.
c. Start-up year 1984.

Table 8b. Annual activity released in liquid effluents from Bruce NGS "B"

Year[c]	Radionuclides[a]	Tritium	% DRL	Gross Beta	% DRL[b]
1984		0.6	<0.01	0.7×10^{-2}	0.02
1985		21.5	<0.01	0.7×10^{-2}	0.02
1986		93.2	0.02	1.3×10^{-2}	0.04

a. All units are in TBq/a.
b. The most restrictive DRL value of all radionuclides is used to calculate the released percentage of DRL.
c. Start-up year 1984.

Table 9a. Annual activity released in gaseous effluents from Gentilly-1 NGS

Year[c]	Radionuclides[a]	Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]
1972		190.0	0.02	2.7×10^{-2}	0.80	4.5×10^{2}	1.00	ND	-
1973		54.0	<0.01	ND	-	ND	-	ND	-
1974		95.0	<0.01	ND	-	ND	-	ND	-
1975		68.0	<0.01	ND	-	1.0×10^{2}	0.20	ND	-
1976		41.0	<0.01	ND	-	ND	-	ND	-
1977		35.0	<0.01	ND	-	0.7×10^{2}	0.15	ND	-
1978		23.0	<0.01	ND	-	ND	-	ND	-
1979		13.0	<0.01	ND	-	ND	-	ND	-
1980		9.9	<0.01	ND	-	ND	-	ND	-
1981		9.5	<0.01	ND	-	ND	-	ND	-
1982		5.1	<0.01	ND	-	ND	-	ND	-
1983		1.3	<0.01	ND	-	ND	-	ND	-
1984		ND	-	ND	-	ND	-	ND	-
1985		ND	-	ND	-	ND	-	ND	-
1986[d]		ND	-	ND	-	ND	-	ND	-

ND - not detected

a. All units are in TBq/a except for noble gases (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.

b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of DRL.

c. Start-up year 1970.

d. Since April 1986, the station has been in the shutdown state.

Table 9b. Annual activity released in liquid effluents from Gentilly-1 NGS

Year[c]	Radionuclides[a]	Tritium	% DRL	Gross Beta	% DRL[b]
1972		62.0	0.07	200.0×10^{-2}	40.80
1973		14.0	0.01	12.0×10^{-2}	2.40
1974		41.0	0.04	4.1×10^{-2}	0.80
1975		14.0	0.01	5.6×10^{-2}	1.10
1976		260.0	0.29	0.7×10^{-2}	0.10
1977		1300.0	1.44	2.0×10^{-2}	0.40
1978		2.1	<0.01	1.0×10^{-2}	0.20
1979		0.3	<0.01	1.6×10^{-2}	0.30
1980		0.4	<0.01	0.2×10^{-2}	0.04
1981		8.0	<0.01	0.2×10^{-2}	0.04
1982		0.05	<0.01	0.1×10^{-2}	0.01
1983		0.08	<0.01	0.4×10^{-2}	0.08
1984		0.1	<0.01	0.1×10^{-2}	0.02
1985		ND	-	ND	-
1986[d]		0.3	<0.01	0.1×10^{-2}	0.02

a. All units are in TBq/a.
b. The most restrictive DRL value of all radionuclides is used to calculate the released percentage of the DRL.
c. Start-up year 1970.
d. Since April 1986, the station has been in the shutdown state.

Table 10a. Annual activity released in gaseous effluents from Gentilly-2 NGS

Year[c]	Radionuclides[a]	Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]
1983		4.3	<0.01	ND	-	63.3	0.08	ND	-
1984		49.5	0.01	ND	-	25.9	0.03	ND	-
1985		53.2	0.01	7.4×10^{-7}	<0.01	119.1	0.15	1.1×10^{-5}	<0.01
1986		122.3	0.03	2.3×10^{-4}	0.01	49.9	0.06	4.6×10^{-5}	0.01

ND = not detected

a. All units are in TBq/a except for noble gases (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.

b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of the DRL released.

c. Start-up year 1982.

Table 10b. Annual activity released in liquid effluents from Gentilly-2 NGS

Year[c]	Radionuclides[a]	Tritium	% DRL	Gross Beta	% DRL[b]
1983		0.8	<0.01	0.5×10^{-3}	<0.01
1984		14.1	<0.01	6.8×10^{-3}	<0.01
1985		27.3	0.02	7.9×10^{-3}	0.09
1986		42.3	0.03	2.5×10^{-3}	0.03

a. All units are in TBq/a.
b. The most restrictive DRL value of all radionuclides is used to calculate the released percentage of the DRL.
c. Start-up year 1982.

Table 11a. Annual activity released in gaseous effluents from Point Lepreau NGS

Year[c]	Radionuclides[a]	Tritium	% DRL	Iodine -131	% DRL	Noble Gases	% DRL	Particulates	% DRL[b]
1982		0.2	<0.01	ND	-	0.1	<0.01	ND	-
1983		25.0	<0.01	9.6×10^{-6}	<0.01	3.9	<0.01	ND	-
1984		68.0	<0.01	ND	-	ND	-	ND	-
1985		110.0	<0.01	4.2×10^{-6}	<0.01	0.8	<0.01	ND	-
1986		200.0	0.01	2.9×10^{-6}	<0.01	5.0	<0.01	ND	-

ND = not detected

a. All units are in TBq/a except noble gases (1 TBq = 10^{12} Bq=27 curies). Since noble gases are inert and do not interact with the human body, one can measure the external dose from the mean gamma ray energy per disintegration rate of all noble gas radionuclides present. The unit for noble gases is gamma TBq.MeV/a.

b. The most restrictive DRL value of all radionuclide particulates is used to calculate the released percentage of the DRL.

c. Start-up year 1982.

Table 11b. Annual activity released in liquid effluents from Point Lepreau NGS

Year	Radionuclides	Tritium	% DRL	Gross Beta	% DRL[b]
	1982	0.5	<0.01	0.02×10^{-3}	<0.01
	1983	9.1	<0.01	3.0×10^{-3}	<0.01
	1984	68.0	<0.01	13.0×10^{-3}	0.01
	1985	24.0	<0.01	1.6×10^{-3}	<0.01
	1986	110.0	<0.01	1.1×10^{-3}	<0.01

a. All units are in TBq/a.
b. The most restrictive DRL value of all radionuclides is used to calculate the released percentage of DRL.
c. Start-up year 1982.